mean the wheat hominy, and which must have been employed as food from the earliest ages, might have been recommended in some work I had not met with. The long period during which I have seen its effects not having enabled me to discover that it had anywhere been formally and distinctly advised, it has appeared more proper to give the public a distinct knowledge of its use, than to hold it back because it may have been recommended by other people.

I cannot conclude without repeating that, of all the articles of food which, in the course of fifty years practice, I have had occasion to recommend for the prevention of a constipated state of bowels, and its consecutive evils, this cracked wheat is incomparably the most effectual.

BOSTON, *Feb.* 1, 1850.

ART. II.—*Notice of some Experiments in Heating and Ventilating Hospitals and other Buildings, by Steam and Hot Water. With Remarks.* By THOMAS S. KIRKBRIDE, M. D., Physician to the Pennsylvania Hospital for the Insane. (With three wood-cuts.)

DURING the early part of the year 1846, the wards of the North Wing of the Pennsylvania Hospital for the Insane became so crowded, that it was deemed necessary to put up additional buildings on the north and south sides of the detached structure, which had been erected some years before. No inconsiderable amount of experience with the ordinary mode of warming with hot air furnaces had shown so many defects and inconveniences in that plan, that it was felt to be particularly desirable, while putting up new buildings, to introduce other arrangements of a more efficient character.

Believing that steam was the most desirable agent to be employed for this purpose, I availed myself of the skill and practical knowledge of Thomas T. Tasker, of the well-known firm of Morris, Tasker & Morris, of Philadelphia, who, after learning what was important in such an arrangement, matured a plan, by which not only the new buildings, but also the old detached structure, to which they were joined, could be warmed from a single tubular boiler of large size, placed in the cellar of the extreme new building, and having steam-pipe distributed in six distinct air-chambers.

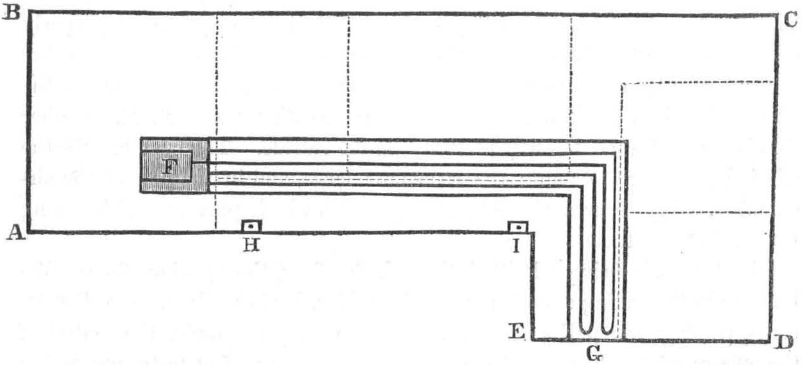
No doubt was entertained of the success of this plan; but the late period in the season, when it was fully arranged, and the absolute necessity for having heat in the wards already full of patients, before the new apparatus could be completed, forced me very reluctantly to abandon the project, and to resort to other means that could be sooner put in operation, and that would not interfere with the fixtures already in use in the detached structure. The original plan, at that time, was considered of too expensive a character to justify its introduction into the new buildings alone.

Although this mode of heating by steam was temporarily abandoned at the Hospital for the Insane, it was subsequently adopted by the Board of Managers of the Pennsylvania Hospital in the city of Philadelphia, for warming the West Wing of that institution, as will be described on a subsequent page.

The most southern of the two additions made to the North Wing of the Hospital for the Insane, in 1846, was completed by the close of that year, and has since that time been very satisfactorily warmed by means of a mild hot water apparatus, requiring little more care or attention than a common hot air furnace.

The form of this building, its divisions, and the position of the air-chamber, are shown by the annexed cut, Fig. 1. It has a front from A to B of twenty feet four inches, is seventy-seven feet on its south side from B to C, and twenty-nine feet from C to D. It is divided into five rooms of different sizes, opening on a corridor. The ceiling is thirteen feet four inches high. There are sixteen outside windows, none less than six by three and a half feet, and it has four outside doors. The amount of air to be heated is 22,000 cubic feet.

Fig. 1.



Scale 20 feet to the inch.

The heating apparatus consists of a cast iron boiler, of what is called the D shape, three feet seven inches long and two feet six inches wide, holding about twenty-six gallons of water. The fire surface is two feet by one foot and a half. It has a good downward draft, regulated by a valve in the chimney. The boiler is placed in the air-chamber at F, the room for coal, ashes, &c., being between this point and the eastern wall of the building. Water is supplied to the boiler from a small iron tank, at a sufficient elevation, on the outside of the chamber wall, and through this tank steam is blown off, whenever the fire is sufficiently active to generate it, which rarely occurs. A cast iron pipe, eight inches in diameter, passes from the top of the boiler, and unites with four other pipes, which are four inches in diameter, and each fifty-four and a half feet long. These pipes convey the water *from* the boiler, to which it is returned by the same number of pipes of equal size and length, the latter terminating near its bottom. The upper range of pipes is within two feet of the top of the chamber, the other twenty inches below the first named. These pipes are supported on iron bars, so as to move easily, as expansion and contraction take place, and contain three hundred and forty-eight gallons of water, and, when in use, an active circulation is constantly going on through them. Only about four gallons of water are put into the boiler daily. A small pipe leads to the water reservoir, from the extreme end of the pipes, to allow air to escape from them.

The air-chamber, extending from F to G, is sixty-seven feet long, three feet wide, and seven feet high. The fresh air is admitted from outside windows into capacious air reservoirs, and from them, through small openings, equally distributed near the bottom of the air-chamber, directly into it. These external windows are all glazed, so that the supply can be properly regulated. The total amount of openings for the admission of fresh air makes a space 160 by 16 inches, or 2560 square inches. The north side of the air-chamber is a brick wall, supporting the partition above it. The other side is made of wood, recently plastered on the outside. The openings for the admission of warm air into the rooms are large, and in the top of the air-chamber, being secured above by arrangements which prevent articles being thrown through them.

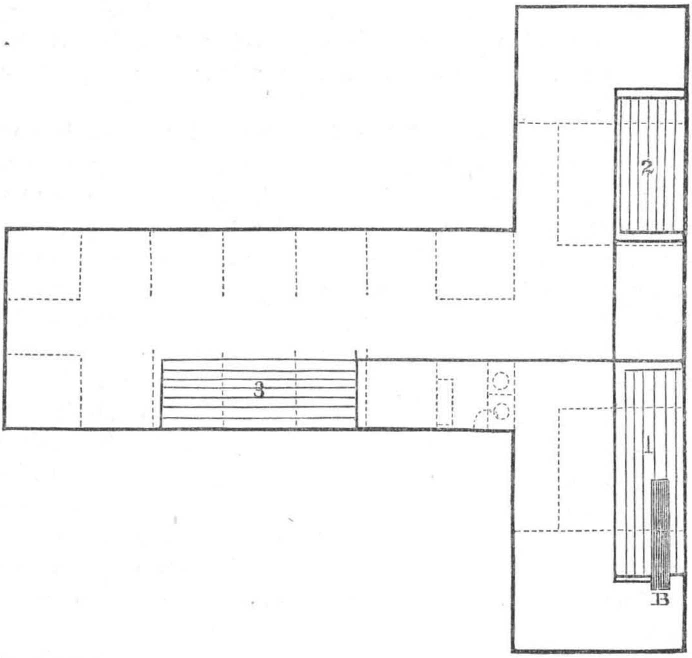
The warm air being admitted through the floor, the openings for ventilation are in the ceiling of each room and corridor, having valves, controlled by cords, passing over pulleys into a room, where they are under the control of the officers of the house. Their size varies from one foot to twenty inches square, and they communicate by means of wooden trunks, with two shafts, H and I, at the bottom of each of which a fire is kindled to force the upward current whenever deemed desirable. The first few feet from the shaft are built of brick, and smoothly plastered on the inside.

This apparatus has now been in use nearly four winters, and in a variety of weather, which enables me to speak confidently of its efficiency. On several occasions, regular hourly observations were made during the day and night, and the results carefully noted. It may be sufficient to say that, using anthracite coal as fuel, the fire requires attention, in severe weather, every two hours, and the amount of fuel used in the whole season is about sixteen tons. When the water is cold, it can be raised to the boiling point, and of course a good circulation established in about two hours. When in operation, the upper pipes, or those leading from the boiler, within five feet of it, show a temperature of 176° Fahr.; and at about the same distance from the boiler on the lower or return pipes, a temperature of 151° F. The temperature of the air at the top of the air-chamber has never been noticed higher than 146° F., and it is commonly at about 120° F., and lower in proportion to the state of the fire, the external temperature, and the amount of fresh air admitted into the air-chamber. In severe weather, with a full supply of fresh air, the ventilators open, and a good fire, the temperature in the different rooms and halls varied from 60° to 75° F.

The removal of the insane from the Pennsylvania Hospital in the city of Philadelphia, in 1841 and 1842, left the whole West Wing of that building to be appropriated to other purposes. After undergoing a most thorough repair, and having various additions and alterations made to fit it for the purpose, it was opened in 1847, for the reception of sick women and children exclusively, and may now be regarded as exhibiting some of the best arranged and most comfortable wards to be found in any hospital. Among the improvements made, the most important is the change in the system of heating and ventilation. This wing consists of a basement, of two principal stories and an attic, all of which were formerly occupied by insane patients, and which are now fitted up so as to be used by the ordinary sick, whenever the resources of the institution admit of the reception of so large a number.

The annexed cut (Fig. 2) shows the form of this wing, the divisions of the two principal stories, and the position of the various air-chambers. The main wards are divided into ten alcoves, five on each side of the central passage, which were made by removing the fronts of the arched rooms, formerly used by the insane, three private rooms for nurses or patients, a bath room, water-closet, &c. Each alcove contains two beds, and a neat curtain in front, without materially obstructing the circulation of air, offers, when required, every

Fig. 2.



Scale 30 feet to the inch.

necessary degree of privacy. The cross wing contains four large rooms and a spacious hall on each story, and the stairway.

The plan adopted for heating this wing is that already referred to as having been originally prepared for the improvements made at the Hospital for the Insane in 1846, and consists of one tubular boiler, fifteen feet long, three feet in diameter, and containing sixty-two flues, with welded iron steam pipe of three-quarters of an inch internal diameter distributed in three distinct air-chambers. The boiler is placed in air-chamber No. 1, on the sketch, which is about twenty-five feet long, nine feet wide, and twelve feet high. There is also in this chamber one range of steam pipe lying on iron brackets, and passing around the upper part of the room. In No. 2, which is of nearly equal size, are also ranges of steam pipe. In No. 3, which is thirty-three feet long, nine feet wide, and twelve feet high, are three ranges of pipe. The black lines give the ground-plan of the building and the air-chambers; the dotted lines show the divisions of the principal stories.

The condensed steam from all these chambers is brought back to the boiler by gravity, and in ordinary weather is nearly sufficient to supply it with water. A connection with the hot water tank in the attic makes it easy to remedy any deficiency.

The two principal stories and the attic are warmed by fresh air received directly from the various air-chambers, the cold air to supply them being admitted from the external atmosphere through large trunks, which pass under the floor of the basement. Direct radiation from steam pipes, placed in the passages and rooms of the basement, gives ample heat to this section of the building, no part of which is now ordinarily occupied by patients.

The hot water for bathing, and all other purposes, is also furnished by a coil of steam pipe, placed near the bottom of the large water tank in the attic, and from which it is distributed in different parts of the building.

Steam, with a pressure of thirty pounds to the inch, to which it is recommended to be raised, before being allowed to pass into the small pipes, can be generated in about one hour from the kindling of the fire; and the consumption of fuel, in severe weather, is about 1500 pounds of anthracite coal per day. The fire requires attention, in ordinary weather, at least every two hours; steam being kept up at night by the watchman occasionally replenishing the fire. The fire-grate for this boiler is 2 feet 9 inches by 2 feet 7 inches.

The amount of air heated by this apparatus is about 170,000 cubic feet.

The warm air is admitted into the different wards near the floor, and the ventilators are in or near the ceiling, the foul air passing out through flues, that are carried up several feet above the roof of the building. Several of the gas lights are arranged directly under the central ventilators.

The flues used for the admission of warm air, and the discharge of foul, are those which were in the building when hot air furnaces were in use, and, although numerous, are smaller than is desirable; and some of them have the decided objection of carrying the air for two stories through the same flue. Although the ventilation is forced but little, yet, when joined to the mode of heating now in use, it is a most striking improvement upon anything previously done in that institution. The air of these wards is at all times totally different from that in those heated by even one of the best constructed air furnaces I have ever seen, and the ventilation is sufficiently active to give great satisfaction to those who have the best opportunities for observing it. Every part of these wards can be kept, in the severest weather we have in this climate, at any temperature not exceeding 75 or 80 degrees. The apparatus has been in regular use since it was first put up in 1847.

In 1849, it had again become necessary to add to the buildings of the Pennsylvania Hospital for the Insane, and it was then determined to use steam for the purpose of heating the new structures, and, at the same time, to fit up an apparatus sufficiently extensive to allow the removal of four large hot air furnaces, and one perpetual hot water boiler, from the detached building, to which the additions in progress were to be connected. In the annexed sketch (Fig. 3), the old structure is bounded by *a*, *b*, *c*, and *d*, and the additions just put up are on the north and south sides of that building. The whole of this range of buildings is of one story; in the new parts, the ceilings are thirteen feet four inches high; in the old structure, the ceilings of the rooms are ten feet eight inches high, and of the halls nine feet eight inches.

The outlines of the building and of the air-chambers are shown by black lines, the dotted lines showing the divisions of the rooms above. B B are the boilers, C the cast iron gas pipe, passing up one of the ventilating shafts, all of which are marked V. D is the main steam pipe, going to the different air-chambers, which are numbered 1, 2, 3, 4, 5, 6, and 7: Nos. 1 and 2 are in the south new addition, Nos. 3, 4, 5, and 6, in the old structure, and No. 7 in the north new addition.

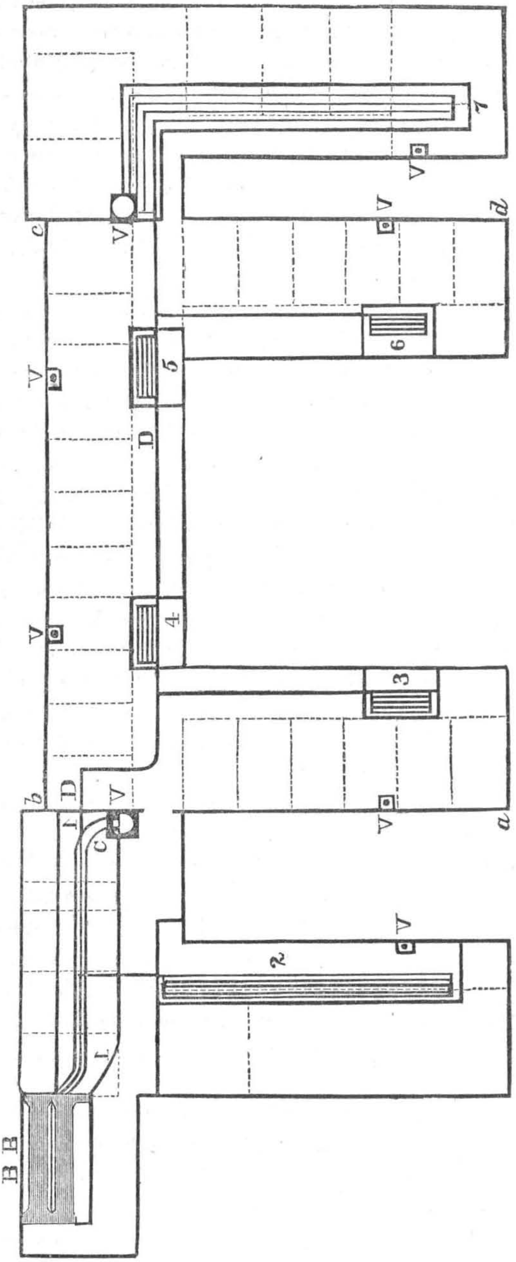
The whole amount of air to be kept warm amounts to 103,000 cubic feet.

The steam apparatus put up in these buildings consists of two tubular boilers, each having thirty-six flues, and being twelve feet and a half long, and two feet six inches in diameter, which are placed in the cellar of a drying room, erected immediately adjoining the south wall of the building occupied by patients—of steam pipe distributed in seven distinct air-chambers, and also of fixtures for forcing the ventilation, and heating all the water required in this range of building.

Anthracite coal is commonly used as fuel, and, in severe weather, from 900 to 1000 pounds are consumed daily, the fires being kept up from 5 A. M. to 10 P. M. About 35 bushels of coke, from the Philadelphia Gas Works, have been found sufficient for the same period.

From cold water, steam, at a pressure of thirty pounds to the inch, can be raised in a little more than one hour from the time of starting the fire. Ordinarily, when the fires have been covered up, and the water in the boilers kept

Fig. 3.



Scale 30 feet to the inch.

at a somewhat elevated temperature, a little more than half an hour is all that is required.

The gas from the boiler fires is carried off through a cast iron pipe one foot in diameter, which, after passing forty-four feet through air-chamber No. 1, ascends, in the centre of one of the large ventilating shafts, to a point twelve feet above the roof of the building.

Air-chamber No. 1 is 40 feet 6 inches long, 5 feet 9 inches wide, and 7 feet high; No 2 is 49 feet long, 8 feet 5 inches wide, and 6½ feet high; Nos. 3, 4, 5, and 6, are in the place of the old air furnaces, and average 12 feet long, 8 feet wide, and 7 feet high; No. 7 is 68 feet long, 7 feet high, and, in 52 feet of its length, 6 feet wide, the remaining part being only 4 feet 3 inches wide.

No. 1 has in it, in addition to the gas pipe already referred to, the main steam pipe leading to the other air-chambers, the steam pipes leading to the water tank and ventilating shafts, and the various pipes returning condensed steam to the boilers. In No. 2 are a set of steam pipes, each having an internal diameter of three-fourths of an inch, placed within one foot of the top of the chamber in two ranges. In Nos. 3, 4, 5, and 6, pipe of the same size has been fitted up on a neat iron frame, so that each chamber has in it about 450 feet of steam pipe. No. 7 has in it a set of steam pipe extending its whole length, and, like No. 2, in two ranges near the top of the chamber. All these pipes so rest on iron supports, that expansion and contraction are fully provided for.

A school-room, 31 by 14 feet, in the basement of one of the new buildings, owing to its position, is warmed by a range of steam pipe placed against its eastern wall. Direct radiation from these pipes was unavoidable in this room, from its being on a level with the air-chambers.

From each air-chamber, a branch pipe conveys the condensed steam into one of the main pipes, which return this water from all the steam pipes to the boiler, which they enter in its lower part. Connected with the boilers is also another pipe, through which all the condensed steam, or the water in the boilers, can at pleasure be allowed to flow into a well, dug in the cellar for that especial purpose.

To all the air-chambers for the new buildings, viz., Nos. 1, 2, and 7, fresh air is first admitted from the external atmosphere through various glazed windows into capacious air reservoirs, and from them into the chambers through small openings regularly distributed in their whole extent, and made by leaving out the width of each alternate brick to a height of nine inches. In Nos. 3, 4, 5, and 6, the fresh air, after being carried from the external opening through a wooden trunk, passes under a board floor one foot above the ground surface, with radiating partitions under it, till it comes directly below the ranges of steam pipe. All the air-chambers are smoothly plastered, and have mortar floors. Air-chamber No. 1 has 55 small openings, made as previously described; No. 2 has an equivalent to 55 of the same kind; and No. 7 has 90 of the like description.

The space for the admission of cool air into the air reservoirs for air-chamber No. 1, may be made equivalent to 1200 square inches, for No. 2, 1500 square inches, into Nos. 3, 4, 5, and 6, each 352, and into No. 7, 2240 square inches. The openings for the admission of warm air from the air-chambers into the apartments above are all large, but of different sizes, passing directly through the floor, and secured by various contrivances, which regulate the size of the opening and also effectually prevent articles being thrown through them.

The openings for the admission of warm air from No. 1, are equal to 640 square inches, from No. 2, to 1104 square inches, from Nos. 3, 4, 5, and 6, to 432 square inches each, and from No. 7, amount to 1520 square inches.

For the ventilation of these buildings, a shaft, 2 feet 6 inches in diameter, circular inside and smoothly plastered, has been put up where the north addition joins the old structure, and another, 13 inches square, adjoining the infirmary. In the same relative positions on the south side, are two similar shafts, one 2 feet 6 inches in diameter, the other 13 inches square. There are also four ventilating flues, each 13 inches square, in the old structure, formerly used as gas flues for the hot-air furnaces. In the lower part of all these ventilating flues, with one exception, a coil of steam pipe, containing from 30 to 75 feet, is placed, and by which the air is heated whenever deemed desirable. In one of the large shafts, the twelve inch iron gas pipe from the boilers is carried up, as a substitute for the steam coil in forcing ventilation.

The ventilating openings are in the ceiling; through these the foul air passes into the attic, and thence into the various shafts already referred to. These openings fully equal the amount of space for the admission of warm air below.

For supplying warm water for bathing and all other purposes, in the 5th, 6th, 7th, and 8th wards, an iron tank, holding 900 gallons of water, has been placed in the attic, and has a coil of steam pipe near its bottom, by which the water can be kept at any required temperature.

The apparatus for forcing ventilation and heating water, forms a system entirely distinct from that for warming the building, and they may be used separately or together, as may be convenient.

From the ash-pits of the boilers, a brick flue passes under ground the whole length of air-chamber No. 1; and, at its extremity, enters the bottom of the main shaft. The draft in this flue is good, and it will always be used for the gas from the fires, in warm weather, when the boilers are in operation to force ventilation, heat water, &c.

The safety valves of these boilers are so arranged, that they always open when the pressure reaches thirty pounds to the inch. This amount of pressure is only used for first letting steam into the pipes in the morning, to secure a quick circulation. Twenty pounds are very often used, even at this time; and, when in full operation, in ordinary weather, ten pounds to the inch are quite sufficient.

Both boilers have generally been used since the apparatus was put up, but it has been ascertained by experiment that one will be quite sufficient in mild weather. Both will probably be required during four months of the year, and one during the remaining period in which heat is required in the wards. To preserve the boilers from injury during the summer, they will be used alternately for heating water and forcing the ventilation.

After the steam is let into the pipes, between five and six o'clock in the morning, no water is required to be introduced from the tank during the day, the condensed steam returning to the boiler keeping it fully supplied. The fire being allowed to go down during the night, to insure a rapid circulation of steam through the pipes in the morning, all the condensed steam in the return pipes is allowed to flow into the well; and that much water is then required to be introduced into the boiler from a pipe connected with the reservoir in the dome of the centre building. If the steam were kept up all night, the amount of water used would be exceedingly small. Emptying the condensed steam into the well every morning, not more than forty or fifty gallons of water are used daily.

In addition to the different fixtures already described, all of which belong to one or the other branch of the Pennsylvania Hospital, it may not be uninteresting, to inquirers on the subject, to be referred to others of a somewhat similar kind, which have been put up since 1846, and which are now in regular use in other places.

The most extensive experiment in heating by this mode of using steam, yet tried in this country, is that which has been in operation during three winters at the New Jersey State Lunatic Asylum, near Trenton. This building presents a front of about 500 feet, and is in no part less than a basement above ground, and two principal stories in height. This large structure is warmed in every part by steam, generated by four large tubular boilers, placed in the cellar of the centre building. The steam is distributed in welded iron pipes, of the same size as those already referred to as being used here, in large air-chambers, twelve feet wide and about seven feet high, extendingthe whole length of the building. The warm air flues pass directly upwards from the top of the air-chamber into the different stories, and discharge near the ceiling, or near the floor, according to the character of the room into which the air is admitted. The foul air flues lead to nine large ventilating shafts, none less than two feet seven inches in diameter, and near the bottom of which a large coil of steam pipe is introduced for forcing the upward current of air.* The amount of air heated by this apparatus is 664,000 cubic feet.

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* Vide Report of New Jersey State Lunatic Asylum, by H. A. Buttolph, M. D. Trenton, 1848-9.

In addition to the warming of the building, these fixtures supply the steam for heating water for all the bath-rooms, and for all other purposes; for forcing ventilation, cooking, &c. The consumption of anthracite coal, in severe weather, may be as high as three tons per day; and varies from that to one and a half tons per week, used in summer.

This apparatus, as before remarked, has now had a trial of three winters. It gives at all times an abundance of fresh warm air of a delightful kind, and is highly valued by those who have charge of the institution.

The offices of the Philadelphia Gas Works, in Seventh St. above Chestnut, are warmed by a mild hot water apparatus, somewhat similar in principle to that put up in this institution, and already described. The air-chamber is of large size, nearly square; the pipes are of cast iron, four inches in diameter; the boiler is of cast iron. Every part is very accessible. The fresh air comes from the external atmosphere, passes under a board floor, through which it escapes by a large number of small apertures, directly below the water pipe. This apparatus is a very complete one, and well calculated for private dwellings.

During the last summer, a steam apparatus was put up in the New Jersey State Prison, at Trenton, by means of which one wing of that establishment is now heated. Owing to difficulties connected with the original construction of that prison, and other causes, it was deemed necessary to depend upon direct radiation from steam pipes for heating the different apartments, and upon the introduction of a sufficient amount of cool air for ventilation. The large corridor, extending to the roof, and ninety-six cells in two stories, are thus heated. Each cell has a tubular radiator in it, which presents sixteen feet of superficial surface; the amount of steam allowed to enter which, is easily graduated, outside of the cells, by an officer of the prison. For generating this steam, two tubular boilers, one size larger than those used in this hospital, are placed in the cellar, at one extremity of the wing. The amount of air heated is 245,000 cubic feet.

All the different arrangements for heating by steam and hot water, noticed in the preceding pages, have been put up in a very superior and workmanlike manner, by the firm of Morris, Tasker & Morris, of Philadelphia. These gentlemen have devoted much attention to the subject, and it is but justice to them to add, that all their experiments have thus far been highly successful.

During the last summer, the Board of Guardians of the Philadelphia Alms House determined to introduce a system of steam heating, connected with a forced ventilation, into one-half of that portion of their building occupied by the insane. This is a very extensive structure, with large rooms, and ceilings near twenty feet high; so that the amount of air to be warmed is between six and seven hundred thousand cubic feet; almost as much as the whole of the New Jersey Asylum. To effect this object, two cylindrical boilers, about forty feet long and three feet in diameter, are placed in the cellar, and coils of small steam pipe distributed through long air chambers, of varying width and height. The fresh air is admitted from the external atmosphere into air reservoirs, and then, through small openings, into the air-chambers. The warm air passes from the top of the air-chambers, and through wooden flues, to the different stories, into which it discharges near the ceiling. The foul air is drawn off near the floor, and carried to a main ventilating shaft, having a clear diameter of about six feet, and in which the upward current is strongly forced by heat from the boilers, and from a special fire kindled at its base.

These fixtures were put up by Birkinbine, Martin & Trotter, of Philadelphia.

There is also, in the detached lodge for insane females, at the same institution, a mild hot water apparatus for heating that building. A common cylindrical boiler, ten feet long and eighteen inches in diameter, is placed at one end of the air-chamber, which extends the whole length of the building. Six four inch cast iron pipes, each 125 feet long, are used for the circulation of the hot water. This building is 131 by 26 feet; has a hall 12 feet wide on its north side, and 12 rooms on the south side. The ceiling is 12 feet high.

In addition to the foregoing fixtures for heating and ventilation by the use of steam or hot water, which may now be seen in use in the vicinity of Philadelphia, and the result of which appears to be perfectly conclusive as to the practicability and efficiency of such means for any weather we have in this section of country, it may not be amiss to refer to two other recent experiments with the same agents, in a district where the degree of cold is much greater than with us.

In the Maine Hospital for the Insane, at Augusta, where the thermometer is often for considerable periods below zero, a steam apparatus for heating has been introduced with entire success. A common cylindrical boiler, twenty feet long and thirty inches in diameter, is there used; and instead of the small, welded iron pipe commonly adopted in this vicinity, six inch cast iron steam pipes are placed in the air-chambers in the cellar, extending the whole length of the wing. Wood is used for fuel, and the consumption is about half a cord daily, the fires being kept up from 5 A. M. to 9 P. M. An engine of five horse power, driving one force pump for raising water to the attic, and another for replenishing the boiler, constitutes a part of these fixtures. The amount of fuel required for all these purposes, and heating a wing containing seventy-five patients, is considerably less than is required for the furnaces used in either of the other wings occupied by fifty-two patients. The warm air flues open into the corridors seven feet above the floor, the ventilating flues have openings near the floor, and also near the ceiling, and lead to the attic.*

The success of this attempt to warm by steam was so satisfactory, that an apparatus somewhat similar has since been substituted for the hot air furnaces previously used in another wing of the building.

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* Vide Report of Maine Insane Hospital. By James Bates, M. D. Augusta, 1849.

At the McLean Asylum for the Insane, near Boston, Mass., a considerable part of one wing of that extensive structure is now thoroughly warmed by a mild hot water apparatus, connected with a very efficient forced ventilation. A vertical tubular boiler, eight feet in height and thirty inches in diameter, is used, and the water pipes in the air-chambers are of cast iron, four inches in diameter, connected with spigot joints and iron cement. The heated air is, in all cases, admitted near the ceiling, and the foul air is drawn off near the floor, and conveyed to the main ventilating shaft, which is circular, six feet in diameter at its base, and about three feet at its upper termination, being a height of seventy-five feet. The cast iron gas pipe from the boiler is one foot in diameter, and running up the centre of this shaft, a distance of fifty feet, constitutes the moving power. Anthracite coal is used as fuel.*

The gentlemen having charge of these institutions have devoted much attention to the subject of heating and ventilation, and speak in decided terms of the success which has attended their experiments.

Remarks.—The subject of heating and ventilating buildings is one in which every individual has a direct interest, and the constant inquiries for improvements in the means for effecting these objects, is among the best proofs how imperfect and unsatisfactory are most of those heretofore employed. The experiments detailed in the preceding pages possess value, as exhibiting to inquirers on the subject the actual results of several trials of two important agents, and the whole arrangements connected with which are open to the inspection of all who wish to examine them. To answer some of the many inquiries frequently addressed to the writer, he has, without aiming at any special novelty, added some remarks, embracing his own present views on the subject and some of the conclusions to which he has arrived, after carefully observing the practical working of most of the kinds of heating apparatus used in this section of country.

An abundance of pure air of a proper temperature is obviously so essential to the health and comfort of every one, that it is a matter of astonishment that, in the construction of both public and private buildings, no part of the original plan, as a general rule, receives so little attention as that which relates to their heating and ventilation. In some of the most costly public buildings in the country, the plan for heating has not even been asked for till the structure was nearly completed; and in almost any proposal for putting up an edifice, in which the architect has chanced to make special provision for ventilation, if the estimates seem too high, that item will be the first to be rejected, even when costly external and internal ornaments, not always in the best taste, are unhesitatingly retained.

Most of our public buildings, in which large numbers of persons are collected even for a limited period, demonstrate very forcibly the want of proper provision for heating and ventilation; and hospitals, whether for the ordinary sick or for the insane, filled as they constantly are with individuals to whom pure air is of especial importance, have suffered more than any other class of structures from these inefficient arrangements; but many of the most costly private residences will also exhibit most strikingly the imperfect mode by which heat is obtained, as well as the almost entire absence of ventilation.

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* Vide Report of McLean Asylum for the Insane. By Luther V. Bell, M. D. Boston, 1849.

Those who have passed any considerable part of their lives in the days of open fires, although they may have vivid recollections of cold currents of air on their backs, while their faces were nearly scorched, still remember a general feeling of comfort—a degree of mental and physical vigour—a certain something which they find wanting in rooms warmed by air that has passed over iron, nearly or quite red hot, while almost every opening that could permit ventilation is carefully closed. No wonder they have pleasant recollections of the open fires of past days, and in their comparisons of the old and most of the new fixtures for heating, find little that is indicative of the great progress of the age. In those days, they had a thorough ventilation if there was but little heat; now, with a superabundance of heat, there is no ventilation.

Any apparatus, to work properly, must supply our apartments with an abundance of pure air, moderately heated, and, at the same time, furnish a steady ventilation proportionate in amount to the number and physical condition of the occupants of the building. Whatever plan effects these objects most effectually, most conveniently, and most economically, is the best.

In private buildings, many contrivances may be used that are not admissible in hospitals, and especially in hospitals for the insane. A well-constructed air furnace to heat the halls, and moderate the general temperature of the upper rooms of a private house, while open fires are used in the parlours and sitting-rooms below, has been found by the few who, valuing health and comfort above the extra cost and trouble of such an arrangement, have adopted it, to afford, with a proper heat, a very desirable kind of ventilation. But in hospitals it will be found best to dispense with open fires in the wards, and to rely upon fixtures in the cellar of the building, which will not only warm an abundance of fresh air from the external atmosphere, preparatory to its admission into the rooms above, but also give power enough for affording a thorough forced ventilation.

Hot air furnaces being rejected as uncertain and unsatisfactory in their operation, steam at a low pressure, or hot water, of a temperature not higher than 212° F. at the boiler, will be found the most desirable agents that can be employed for these purposes. These, it is to be understood, however, are only recommended when used for heating fresh air preparatory to its admission into the rooms above, as before stated, and not for heating the air already in them. The plan of obtaining warmth by direct radiation from steam pipe placed in the different apartments, and kept hot by the waste steam from the boilers, as is extensively used in manufactories, although a very economical mode of obtaining heat, is highly objectionable, and ought not to be adopted where any active ventilation is desirable.

Used as proposed, and with the boilers, as will be recommended on a subsequent page, placed outside of the building, steam and hot water have many important recommendations. With such an apparatus, the danger of accidental fire is much lessened; for all fire may be dispensed with in the building, except for some kinds of cooking, baking, and ironing: all the dust and dirt from taking in and moving the coal, and carrying out ashes, and all the annoyance from the escape of gas from imperfect pipes or making fires, is completely avoided. The air cannot be excessively heated, and when freely admitted into the wards, seems like a summer breeze.

There appears to be little doubt that either steam or warm water will effect every desired object, and, judging from our experiments, without any material difference in cost. For private dwellings, the hot water is most desirable; it is perfectly safe, there is no objection to the boiler being in the cellar, and any one who can take charge of a common fire can attend to it; but in large establishments, where it will be necessary to keep a regular fireman, steam is to be preferred. This person will be responsible for the apparatus being kept in order; and as steam can be made to circulate more rapidly, little inconvenience will be experienced if the fires should happen to go down. The distance from the boiler at which steam can be conveniently used, and the small size of the pipes in which it may be conveyed, render it almost impossible to calculate the extent to which this wonderful agent, which is revolutionizing so many of the operations of mankind, may yet be employed in supplying warmth to the inhabitants of cities. There seems to be no reason why housekeepers and the proprietors of stores should not, at some not very distant day, buy heat for their dwellings as they now do light and water. Preparing the air-chambers in their cellars, steam could be delivered to them for circulation in their pipes, by any enterprising person, who, selecting a cheap location in the rear of a range of dwellings or stores, might entirely underground, have all the fixtures necessary for supplying steam to a whole square, the residents of which, in addition to the important matter of being saved from one great source of accidental fire, would be spared the annoyance of getting in coal, making numerous fires, removing ashes, &c. For stores in which the doors are much open, simple radiating pipes in the different rooms might be sufficient, as it would be less costly than the plan recommended for private dwellings.

The distance to which steam can be conveyed in thoroughly protected pipes under or above ground, is one of the features which make it so desirable for warming very large establishments At the distance of one thousand feet from the boiler, when proper care is observed, the force and temperature of the steam do not appear to be materially impaired.

The kind of boiler adopted where steam is used, may depend very much upon the fancy of those who select it, and upon the position which it is to occupy. The tubular boiler has been adopted in several of the fixtures noticed in the preceding pages, and has the advantage of occupying much less space than the common cylindrical one. Steam can be raised more quickly; if well made, they are equally strong; and very little masonry is required in putting them up; while, on the other hand, if not restricted for room, the simple cylindrical boiler is less costly, much less likely to require repairs, and at least as safe.

Whichever kind may be adopted, it is of great importance to secure ample boiler room; the ability to generate rather more steam than we expect to require, is highly desirable; and they should always be used under a very moderate pressure.

In all cases, it is important that two boilers of moderate size should be used, rather than one large one. Under no circumstances should a single boiler be depended on to heat a hospital, or a large section of a hospital; for some accident may occur that would effectually prevent its use for some days in the severest weather; when there are two, the uninjured one would be sufficient to prevent any suffering from such a cause. Besides, a single boiler may be amply sufficient for mild weather, when two would be fully required when the temperature is very low.

The boilers should always be placed outside of the building that is to be heated. They can easily be protected so as to give out but little heat; and the heat from the boilers ought not to be depended upon for warming the rooms that are occupied by patients. Although it seems scarcely possible that an accident can occur to boilers properly made, and properly used, for heating, they should be placed in a position, where all risk to those occupying the building would be removed. Another important reason for such a location of the boilers is that, if in the building, the dust from the coal and ashes, and a certain amount of gas, while the fire is being made, must necessarily escape into the rooms above. When the boilers are outside, the depots for coal, ashes, &c., should also be exterior to the building, easily accessible, and immediately contiguous to the boiler.

The boilers should always be placed so low that there will be no difficulty in the condensed steam returning promptly to them; and upon this source of supply they ought to depend. If this works properly, the greatest source of possible accident is removed. More annoyance has probably arisen from the want of attention to this point, than any other, and has frequently occurred from the boilers being placed inside of buildings, which did not permit any great amount of excavation in their cellars.

For conveying away the gas from the boiler fires, a cast iron pipe, if perfectly tight, may be used; and, in winter, no objection exists to its passing through one of the air-chambers; as, in a good tubular boiler, or a cylindrical one of proper length, the temperature will be found so very moderate, that no injury will result from its presence. It may then be carried up in the centre of a ventilating shaft; but the great absorption of heat by the water in the boiler will prevent its being as effective a moving force as would have been supposed. If this arrangement is adopted, in summer it will be necessary to use an underground flue, and a downward draft, to prevent annoyance from the heat, that otherwise would be communicated to the air-chamber.

Either small welded iron pipe, of a diameter not exceeding one inch, or cast iron pipe of several inches in diameter, may be used in the air-chambers. The small pipe has generally been adopted in this vicinity, from its very great convenience in being put up, and in repairing; for the facility with which it may be adapted to any position, as it can be bent to any form; the readiness with which changes may be made in the fixtures; while its cost is no greater for the same amount of radiating surface.

The air-chambers should always be large, and, if possible, made to extend nearly throughout the length of the building, so that the flues for the different stories and apartments, passing from the top of the chamber, may be as direct as possible. About six feet appears to be a convenient width, and probably gives all the advantages of a wider one; although some which are twelve feet wide, when passing under a central corridor, with rooms on each side, have been found to be unobjectionable, and to give increased facilities for conveying the warm air to the different apartments above. They should be about seven feet high, so that persons may walk comfortably in them, and have ample space for arranging the necessary fixtures. The cold air should be admitted near the bottom of the air-chamber, and regularly, diffused throughout its whole length. It should always come from the external atmosphere, either through a large trunk, underground, or through openings in the cellar windows, into an air reservoir, before it is allowed to pass into the air-chamber. These openings should always be controllable; for the force and direction of the wind, and the external temperature, may modify materially the amount of air that should be allowed to pass through them. The floors of these air-chambers should be of plaster or cement, to prevent dust, and that they may be easily kept perfectly clean.

To permit these arrangements to be properly carried out, the entire cellar of hospital buildings should be excavated; the first cost is but trifling, and the subsequent convenience exceedingly great.

One of the advantages of heating by steam and hot water is, that the air-chambers and flues may safely be made of wood, wherever the use of that article is deemed desirable. In arranging flues in old buildings, where additional space is required, this is often highly important; and, by care, considerable projections may be made in corridors, without at all impairing their general appearance. When air from steam or hot water is used, too much care cannot be taken to make all flues, whether for the admission of warm air, or the egress of foul air, very large—much larger, indeed, than is supposed necessary. In some of the experiments recently made in the use of these agents, the grand defect has been a neglect of this point; many of the flues being, in my estimation, not one-sixth of the size that is desirable to do justice to the system.

A free admission of fresh air into the air reservoir is also important. Firemen generally will be found to have a dread of cold air being allowed to enter the air-chamber in severe weather, and will, consequently, if permitted, close most of the external openings; but a series of carefully conducted experiments in this institution has proved most satisfactorily that a free admission of fresh air is necessary to give full efficiency to the apparatus. Although the temperature of the air reservoir was much reduced, and that of the air-chamber moderately, still in the rooms above the thermometer was found to have risen, and the character of the air materially improved; so that more comfort would have been experienced, even if at a rather lower temperature. In conducting these experiments, another interesting fact was fully established, as has been noticed by others, that, with air from steam pipes, freely admitted, and with an active ventilation, patients were much more comfortable, and expressed themselves as feeling warmer, when the thermometer was at 65°, than with the ordinary hot air from furnaces, at, or above, 70°.

No system of heating can be perfect, or give satisfaction, unless it is connected with a forced ventilation. Although it has been common for us to speak of openings in the walls of our hospitals that simply lead to an attic, as being for ventilation, a few actual trials of the movement of the air in their neighbourhood, would satisfy any inquirer of their utter inefficiency. Windows and doors, at certain seasons, and in certain states of the atmosphere, are valuable as a means of ventilation; and there has always appeared to me an excess of science, when it is seriously proposed to reject all the aid we can occasionally receive from a natural ventilation; but, at the same time, it must be confessed that, when wanted most, little or no ventilation is to be obtained in this way. Those who have been in the habit of showing these openings in the wall, which lead upwards or downwards, as the case may be, but through which no air passes, or, if it does, is quite as likely to go in the wrong as the right direction, although they may have satisfied inquirers, it is no less certain that they have been labouring under a delusion, if they supposed that the wards were ventilated through their agency.

As a forcing power, if the proper machinery was at hand, and could be kept in regular operation, I feel quite satisfied that nothing would be so reliable and so efficient as the fan, warm air being supplied for ventilation. But, as this cannot commonly be effected, it is necessary to resort to other means; although stationary fans, worked by hand, for wards, or movable fans for single rooms, may often be used most advantageously in old buildings, which have been put up without any reference to means of ventilation.

Next to the fan, heat, as a means of forcing the upward current of air in the foul air shaft, is the most valuable, and in some positions is recommended by its convenience. Where a steam apparatus is used, a coil of steam pipe of proper size introduced into the shaft has an admirable effect. The steam jet, where there is an engine worked at a high pressure, is very effective, but where there is as little pressure of steam as I have generally seen in the heating apparatus, used in this vicinity, it is of little value. A cast iron gas pipe from strong fires of any kind, carried up in the centre of a ventilating shaft, is found to add essentially to the activity of the upward current of air, but the heat given out by such a pipe from a tubular boiler I have found to be much less than I had anticipated. Various contrivances, of an old date, are valuable on the tops of these ventilating shafts, in preventing the action of the winds, which otherwise occasionally very materially interfere with the upward current of the foul air.

Both the upward and downward ventilation have advantages and disadvantages which will readily suggest themselves. In many cases it is very convenient to have the warm air admitted near the floor, and the upward ventilation will then be adopted; but for some classes in hospitals for the insane, the admission of the warm air near the ceiling, and the withdrawal of the foul air near the floor, has many highly important advantages to recommend it. Either plan will be successful in a well-matured system, in which the flues are judiciously arranged, and a liberal amount of forcing power used. Without ample forcing power, neither can prove satisfactory.

The experiment of introducing coils of steam pipe into the space previously occupied by hot air furnaces, as detailed in the notice of the apparatus recently put up in the Pennsylvania Hospital for the Insane, is deemed important to institutions now heated by furnaces, as showing with what facility the system may be changed. A slight enlargement of these chambers has been found sufficient to afford space for steam pipe enough to give out more heat than was previously obtained by the furnaces. As commonly arranged, not only the chambers, but the flues of ingress for cold air and egress for warm, will require material enlargement, and the passage of the heated air from the chamber should be made as direct as possible. The Pennsylvania Hospital for the Insane, exclusive of those parts now warmed by steam and hot water, has thirty hot air furnaces, in regular use during severe weather. No doubt is now entertained by the writer, but that two large boilers, placed in a central position, would give sufficient steam to warm air enough in these chambers to heat the whole of the building;—while all the trouble and annoyance of getting into the building and moving several hundred tons of coal, all the dirt and dust from making up the fires, the occasional escape of gas in some positions would be avoided, and a considerable saving in the amount of fuel used would almost certainly result from the change.

In using a steam apparatus in a hospital, it is generally desirable that the temperature should be kept up about as steadily during the night as by day, in order to ensure an equal activity of ventilation. This may occasionally be done by the ordinary watchman keeping up the fire, where the apparatus is conveniently situated, but when very large it should be attended to by one of the regular firemen. When steam is allowed to go down at bedtime, and then raised early in the morning, it will be necessary at the first named hour to close the cold air openings, and somewhat diminish the openings for ventilation. Even by these precautions, the temperature cannot be kept uniform, which is the important objection to this mode of management, although to avoid additional expense it is often adopted.

Although the experiments detailed in the preceding pages have proved, almost invariably, successful ones, it is not to be disguised that attempts in some other quarters have not been equally satisfactory. The heating of fresh air by means of steam and warm water has not as yet become sufficiently well understood by most of those engaged in warming buildings, to render success certain, except by those who have thoroughly matured their plans, and devoted a large amount of study to the subject; but, when undertaken by these, it may be pretty confidently asserted that sufficient experience has now been obtained to do away with all fears of a failure.

The Association of Medical Superintendents of American Institutions for the Insane, at their last meeting at Utica, New York, in 1849, unanimously resolved, "that the experiments recently made in various institutions in this country and elsewhere, prove to the satisfaction of the members of the association, that the best means of supplying warmth in winter, at present known to them, consists in passing fresh air from the external atmosphere over pipes or plates containing steam at a low pressure, or water, the temperature of which at the boiler does not exceed 212° F., and placed in large air-chambers in the basement or cellar of the building to be heated." They also resolved, "that a complete system of forced ventilation connected with such a mode of heating was indispensable in every institution like hospitals for the ordinary sick or insane, and where all possible benefits are sought to be derived from these arrangements," and that "no expense that is required to effect these objects thoroughly can be deemed either misplaced or injudicious."

Comprising, as this association does, the physicians and superintendents of nearly every respectable institution for the insane on this continent, it may be safely asserted that no other equal number of men have had so much cause to lament the great deficiency of most of the present arrangements for heating, and of observing the utter want of ventilation in many otherwise noble buildings, or been compelled to devote so much care and attention to the investigation of the different plans that have been proposed to remedy these evils.

The unanimous declaration of sentiment by such a body of men ought therefore to prove encouraging to those who are about erecting new buildings or making improvements in those already built. The experiments made since the passage of this expression of opinion have fully confirmed its correctness, by practical results of a perfectly reliable character.

The only decided objection likely to be urged against the adoption of these modes of heating and ventilation, is the first cost of the fixtures, for, when in operation, they will be found to be decidedly economical.

The importance, however, of giving at all times an abundance of pure fresh air, of a proper temperature, to the inmates of all hospitals, is so great, that the justness of the declaration of the association just referred to, that "no expense that is required to effect this object thoroughly can be deemed either misplaced or injudicious," can scarcely be questioned. It will be found, indeed, that in all the arrangements of hospitals, true economy consists in doing everything connected with the buildings or fixtures in the best and most substantial manner, and that such a course of proceeding will prove, in the end, not only cheapest, but most satisfactory to every intelligent community.

PHILADELPHIA, *February*, 1850.

ART. III.—*Cases IV. and V. of Large Peritoneal Section.*—By WASHINGTON L. ATLEE, M. D., Professor of Medical Chemistry in the Medical Department of Pennsylvania College, Philadelphia, Penna.

CASE IV. *Operation May 22d,* 1849, *exploratory—tumour uterine and fibrous—not removed—recovery—subsequent death by erysipelas, November 3d,* 1849.—Miss M. T., aged 33 years, of Buffalo, New York, came to Philadelphia May 12th, 1849, to consult me about a tumour of the abdomen. She gave the following history of her case: Seven years ago, she had an attack of typhus fever, and was sick six or eight weeks. Eighteen months after, in the fall, she had what her physician called yellow fever. She has had two or three slighter attacks of fever since. Two years before discovering the tumour, she had an eruption on her body, which lasted three or four weeks, and was treated by Dr. T., of Buffalo, with the bichloride of mercury and sarsaparilla internally, and the ointment of red precipitate externally. The catamenia made their appearance when she was sixteen years old, and they have always been painful up to the period of the attack of typhus fever, after which, they were less so; they have, also, always been regular up to the time of the discovery of the tumour. July, 1845, she first noticed the tumour in the right side, midway between the ribs and pelvis. It was then as large as the fist, larger one way than the other, the larger part projecting upwards. It seemed smooth, hard, and unyielding in its texture, perfectly movable, could be pushed over to the linea alba, could be depressed and elevated, would fall to the opposite side when lying on that side; and, upon removing the pressure, or restoring her position, it would again return to its original position. About three months after this, Dr. P., of Providence, Rhode Island, examined the tumour, the patient, at the time of the examination, lying on her back with the abdomen exposed. He described it as a decanter-shaped tumour, with a neck attached to the right side of the uterus and to nothing else. He could play it about, and considered it an ovarian tumour. During the succeeding winter, 1845–46, it grew to half the size it is now, having enlarged gradually. The following spring, 1846, it again gradually diminished to about one-third its previous size, without any remedial treatment. The succeeding summer it again increased to the size it had been in the winter, and continued to increase beyond this size until the latter part of the fall, when it again diminished, but not so much as before, and also without treatment. It now remained stationary, as to size, until the next fall, 1847, and then again